

SCIENCE

NEW YORK, FEBRUARY 9, 1894.

WE regret the delay in the issuing of *Science*, which is due to its taking longer to install THE SCIENCE PRESS than was expected. Now that the new office is in working order we hope to make up for lost time.

CHARLES BONNET'S IDEA OF THE DEVELOPMENT OF THE CHICK.

CHARLES BONNET, the distinguished naturalist, was born in Geneva in 1720 and died in 1793. He worked assiduously with microscope and lens and devised many new experiments on plants and animals. He was a friend of Haller's and stoutly maintained the latter's doctrine that all the vital functions could be reduced to two—sensibility and irritability. His first important work was the investigation of the life history of aphides, and his interpretation of parthenogenesis was a great triumph to the *ovists*. The process of development in his time was considered by many to be purely a process of unfolding of a preformed germ which contained in miniature the future animal or plant. But the supporters of his idea were divided into two camps: the *animalculists* held that the miniature animal—the germ—was carried in the male seminal fluid to the proper matrix, where it found suitable nourishment and grew—i.e., unfolded. The *ovists*, on the other hand, maintained that the germ existed in female and explained fecundation as a stimulus produced by the male fluid which furnished the first nourishment of the tiny germ. The fact, then, that a female aphide could produce offspring without coupling with a male seemed to give the *ovists* a convincing argument.

His works are interesting reading to-day, for he was not only a keen observer but a careful writer as well. To be sure, his facts are often meagre, and often the results of his or his contemporaries' observations were insufficient to base the broad generalities upon in which he delighted; yet within the knowledge that he had he argued well. Who knows but what the student of a hundred years hence may smile at Weissman's conclusions as we do at Bonnet's? In the following description of the development of the chick the reader should always keep this in mind and should as far as possible forget for the time much of the detail that has become known to us since improved microscopes and sections have been in use. The selection translated below may be found in his "*Contemplation de la Nature*" (tome iv., pt. I, chap. x.), published in 1764:

LA GÉNÉRATION—LE POULET.

An egg not fecund has a yolk like an unfecund egg. The goodwives have known this all the time; and there is in this little fact, so well known, so little examined and so worthy of it, something which comes to throw a flood of light and has cleared away the shadows with which the great mystery of generation has been enveloped.

Give all your attention to this: you are going to put your finger on an important verity. A membrane invests the yolk internally, and this membrane, which is only the continuation of that which covers the small intestine of the chick, is common to the stomach, the pharynx, the mouth, to the skin and epidermis. Another membrane invests the yolk externally, and this membrane is only the continuation of that which covers the intestine: this unites with the mesentery and peritoneum. The arteries and veins which course through the yolk derive their origin from the mesenteric arteries and veins of the embryo. The blood which circulates in the yolk receives from the heart the impulse of its motion.

The yolk is, then, essentially, an appendage of the intestine of the embryo, and together they form an organic whole. Therefore, in earliest times, the chick is, to some degree, an animal with two bodies: the head, trunk and the extremities compose one of these bodies; the intestines and the yolk form the other. At the end of incubation the second body is pushed within the first, and the two make but the one.

But since the yolk exists in eggs which have not been fecundated, it follows necessarily that the germ is pre-existent to fecundation. This consequence stares one in the eyes: you come to see that the yolk is an essential part of the chick. You recognize the direct connection between the one and the other. The chick has not existed, then, without it. The membranes and vessels of it are only a continuation of those of itself. And how many other things there are which they have in common, which prove that they have never existed separately. The chick was, then, entirely in the egg before the fecundation. Then it owes not its origin to the liquor which the cock furnishes: it was defined *en petite* in the egg, prior to the commerce of the sexes. The germ, therefore, pertains exclusively to the female.

The evolution or development proceeds by nutrition; you have seen it. Nutrition supposes circulation; you have seen it also. Finally you have seen that the heart is the seat of circulation. If it does make a circulation in the germ before fecundation you will admit at least that it is not sufficient to perform the whole evolution which will render the germ visible, and which gives to all its parts, the form, proportions and arrangement which characterize the species.

The germ cannot achieve its development in an egg which has not been fecundated, and incubation will only hasten its corruption. Yet what does it lack in order to continue to grow? It has all the organs necessary to evolution. It has taken on itself a certain increase, for eggs increase in virgin pullets; their ovaries contain them in various sizes. The germ may grow, then. Why can it not develop completely? What secret force holds it back in the limits of invisibility?

Growth depends upon the impulse of the heart. A great growth depends upon a great impulse. The heart of the germ which is not fecundated lacks this impulse.

This demonstrates a certain resistance in the parts of the germ. In measure as it grows, this resistance in-

creases. Some parts resist more than others; the osseous parts more than the membranous.

The heart of the germ, then, needs a force proportioned to overcome this resistance. Its force is in its *irritability*, or in the power to contract when brought into contact with a liquid. Augment this irritability, and you augment its impulsive force.

Fecundation increases, without doubt, this force, and it alone can do that: since it is only by its intervention that the germ succeeds in freeing itself from the narrow limits which restrained it in its first stage.

The fecundating liquor is, then, a true stimulant, which, carried to the heart of the germ, excites it powerfully and communicates to it a new activity. This is what we call *conception*. Movement once impressed on this little prime mover is conserved by the unique energy of its admirable mechanism.

But it does not suffice that the heart acquire a force capable of overcoming the resistance of solids: the fluid which it sends them for nourishment must be proportioned to the marvelous fineness of the vessels. A blood such as ours would not circulate. The blood of the embryo at first is a whitish liquid; it turns yellow by degrees and finally becomes red. The impulse of the heart dilates the vessels more, and they admit larger particles, heterogeneous and colored.

The generative liquor is not, therefore, a simple stimulant: it is besides a nourishing fluid, appropriate to the extreme delicacy of the parts of the germ. It fulfilled already in the body of the fertilizing individual the functions of a nutritive fluid: it made the comb and spurs grow and gave strength to all parts. You recall the degeneracy of the capon, and how it differs from the cock. You might have many more proofs that the generating fluid is the first aliment of the germ.

Transported by the arteries to all the parts, it unites with them in a fixed manner, according to the proper nature of each. The chick is not slow to lose its form of tadpole. Wings, legs and feet proceed out of the long tail; everything comes out, fashions itself and arranges itself on a new model. The little animal, stretched out at first in an almost straight line, curves itself more and more. It invests itself more and more with muscles, tendons, bones and feathers, and in 18 or 20 days it is a perfect chick.

B.

VACCINATION.

BY J. N. HALL, M.D., DENVER, COLO.

IN view of the periodical crusades against compulsory vaccination by certain enthusiasts opposed to the practice, I have thought that it might be of interest to the readers of *Science* to look at a few of the results to be deduced from recent statistics upon the subject. The reason why no thoroughly scientific study of the anti-vaccination side of the matter has been made would seem to lie in the fact that no scientific mind could view the situation in a judicial way without seeing that all of the facts are upon one side, and that the one of the advocates of vaccination. With this prelude I will allow the facts to speak for themselves.

In 1874 the compulsory re-vaccination law became operative in Prussia. (See Dr. Sykes's "Public Health Problems," London). By its provisions, every infant must be re-vaccinated, and every scholar in public and private schools must be re-vaccinated at the age of twelve years. If we take the average number of deaths from small pox per 100,000 living in Prussia, we find that for the five years preceding the introduction of compulsory vaccination the number was 113+. Since the

law went into effect, in but one year, up to 1883, has it reached 4 per 100,000. The average is much less. I have not at hand the figures since that time, for the whole population, but in the Prussian army, where all the conditions are under better control, the results are so much better that I will quote them. This is easily done, for with the exception of a single death in 1885, the name small pox has not appeared as a cause of death in the annual reports since the law went into effect. It should be borne in mind in this connection that Prussia is constantly exposed upon its Russian and Austrian borders to the disease.

As to the death rate in vaccinated and unvaccinated persons, we may quote the conclusions of Dr. Barry, in his report of the epidemic of 1887-8, in Sheffield, England. Without quoting the figures, it will suffice to present the statement that "the children vaccinated, had, as compared with the unvaccinated, a 20-fold immunity from attack, and a 480-fold security against death from small pox; the persons over ten years of age, once vaccinated, had a 5-fold immunity against attack, and a 51-fold security against death; and the twice vaccinated, a 31-fold immunity from attack, and a 640-fold security against death."

Inasmuch as the objections to vaccination on the ground that syphilis and leprosy may be transmitted may be completely done away with by the use of heifer-virus, we need not discuss the matter. There is, indeed, a certain element of danger in vaccination, as in every other thing of established value, but it is strange that in the face of such evidence as may be obtained from scores of reports of boards of health, medical departments of armies, etc., etc., there are still found those who deny the value of the most beneficent discovery ever made by man. There is good reason for hoping that we may soon be able to control in similar manner many other of the contagious diseases which have in the past made such havoc with our race.

—"The Political Economy of Natural Law," by Henry Wood, which appears from the press of Lee & Shepard, of Boston, is virtually an enlargement of a work published seven years ago under the title, "Natural Law in the Business World." The author's main thesis, that all industrial operations are governed by natural law, is of course nothing new, nor is his presentation of it more scientific than that of the regular economists, but less so; yet there is much in his book that may be useful if it reaches the right class of readers. Those who wish a thorough and scientific formulation of the known laws of economic life will prefer the regular treatises; but those who do not relish the hard study that such treatises require, and who like a more popular mode of treatment, will find in this work some useful lessons on the matters with which it deals. That the law of supply and demand cannot be set aside by artificial restraints, that combinations of laborers are often tyrannous, and combinations of capital tend to overreach themselves, and that socialism, if once established, would carry within itself the seeds of its own dissolution, though familiar truths to well-informed men, are not so widely known in the business world as they ought to be; and Mr. Wood's statement of them may attract readers who would never read the elaborate works of Mill and his successors. Mr. Wood takes extreme ground against legislation on business matters, but makes an exception in favor of the protective tariff, which seems to be a pet measure of his. On the whole, however, he is open-minded and fair, and his opinions in the main are such as the best economists will approve.

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THE MESABI IRON RANGE.

BY E. P. JENNINGS, IRONWOOD, MICH.

THE discovery and development of this new source of iron ore within the last two years presents many points of interest. The deposits differ from all others in the Lake Superior district in being horizontal, and are only covered by the glacial drift.

The range is situated about 50 miles north of Lake Superior and extends from the Canadian line west to, and probably beyond, the Mississippi River, a distance of about 140 miles. The ore bearing belt is narrow, averaging about one mile in width.

The beds lie on the south flank of the Giant's Range—a chain of granite hills which form the watershed between Lake Superior and Hudson's Bay.

The rock series, according to Professor N. H. Winchell, is as follows:

First. The Archæan granite of the Giant's Range.

Second. Green Schists of the Keewatin-Archæan, dipping at high angles to the south.

Third. Quartzite, unconformable on first and second Taconic.

Fourth. Iron ore and taconite horizon Taconic.

Fifth. Slates and cherts—Taconic.

Sixth. Black slates—Taconic.

Seventh. The gabbro overflow which covers the eastern third of the range, and also appears to the south of the central part of the range.

Small bodies of banded titaniferous ore occur in the gabbro, but these deposits have no value and belong to a different horizon from the vast deposits of the so-called taconite horizon.

The taconite is a grayish, jaspery quartzite, enclosing narrow bands and masses of ore, and is somewhat similar in character to the banded jaspery ores of the Michigan Ranges. Where the conditions have been favorable the ore bodies have been formed by the solution and removal of the silicious rock through the agency of carbonated waters. The iron oxides, being insoluble in this reagent, have been left in various states of aggregation from hard specular and massive hematites to soft hydrated oxides.

The conditions favorable to the solution and removal of the silicious matter from the taconite or banded ore appear to be, first, that the taconite must not have been covered by other rock that would have preserved it from the action of the carbonated waters. So far no ore has been found in the taconite when covered with the black

slates. Second, that a free drainage to these waters was essential; when some barrier was interposed,—as, for instance, the green schists of No. 2 of the series, which in some cases cuts through the taconite, and so prevented the flow of the water saturated with silica,—no enrichment of the lean strata took place.

The quartzite under the taconite has also been acted upon by the carbonated water, for the layers immediately under the ore are disintegrated and have the appearance of a soft white or yellowish sand. Slight streaks of the same sand are also found in the ore, showing that in places the action of the water has not been complete.

About all the known ores of iron are found in these deposits, with the exception of carbonate, such as hard specular, massive hematite, soft blue black hematite, limonite, göthite and some magnetite. The latter can be separated by a magnet from the soft blue hematite. There is little or no pyrite in the ore, and in general the sulphur compounds are absent. The best ore is the so-called "blue" ore, a fine granular blue black hematite, which does not soil the hands as most of the soft ores do. This ore carries from 62 to 68 per cent iron, and phosphorus from .007 to .050 per cent, with small amounts of silica, lime, magnesia, and alumina, and is an ideal blast furnace ore.

Some of the ore basins are very large and show that the concentrating process has been on a very extensive scale. The basin at the Biwabec is about 3,000 feet in length by about 1,000 feet in width, with a depth along the axis of the deposit of 100 feet or more, the deposit gradually thinning out on the northern edge near the granite. This deposit is known to contain 20,000,000 tons of blue ore and possibly as much more of the yellow and brown ores that will run 60 per cent in iron. This is but one of many known basins.

The ore in these beds is nearly horizontal and varies from a few feet to over one hundred feet in thickness and is covered by the glacial drift from a few inches to one hundred feet in depth.

The operation of mining consists of first removing the "over-burden," which is done by steam shovels. Then railroad tracks are laid on this uncovered surface of the ore. The ore is loosened by light blasts of black powder and shoveled and hoisted on cars by steam shovels. Two thousand eight hundred tons of ore have been mined and loaded with a single shovel in a day of twenty hours.

The great hoisting and pumping engines of the deep mines of other districts are here replaced by the tools of a modern railroad contractor—the locomotive and steam shovel. As there is no pumping, no hoisting, no timbering, and as most of the work is done by machinery, no skilled miners are required and few men of any kind. The cost of mining is therefore very low.

Considering both the quality and quantity of ore and low cost of production, this new range is certainly one of the most wonderful discoveries of the century.

—Mr. Goldwin Smith in the preface to his latest book, "Oxford and her Colleges: A View from the Radcliffe," says: "The writer has seldom enjoyed himself more than in showing an American friend over Oxford. He has felt something of the same enjoyment in preparing, with the hope of interesting some American visitors, this outline of the history of the University and her colleges. He would gladly believe that Oxford and Cambridge having now, by emancipation and reform, been reunited to the nation, may also be reunited to the race; and that to them, not less than to the universities of Germany, the eyes of Americans desirous of studying at an European as well as at an American university may henceforth be turned."

PETROLEUM IN SOUTHERN CALIFORNIA.

BY S. F. PECKHAM, UNIVERSITY OF MICHIGAN.

THE history of the development of petroleum in Southern California is very interesting. It first attracted attention just at the close of the war, when the energies of the country were again directed to the development of its material resources. The production of oil upon Oil Creek, Pennsylvania, had assumed such proportions as to stimulate effort in all directions for the opening up of every locality, not only in the United States, but in foreign countries where springs of petroleum or deposits of other forms of bitumen encouraged the possibility of repeating the experiences that had attended the drilling of wells along the tributaries of the Upper Alleghany.

Among the persons who had promoted the enterprises that had borne such fruit on Oil Creek none had been more prominent than Professor Benjamin Silliman, Jr., and his contributions to the scientific press upon the oil springs of Pennsylvania soon became classical. It is not surprising, therefore, that when he announced that a duplicate of the oil region of western Pennsylvania existed in the region south of Point Conception and the coast ranges his utterances were accepted as oracular and that commercial enterprises of unlimited dimensions found the most cordial support from capital on both the Atlantic and Pacific coasts.

The insufficient examination given the subject and the shameful imposition practised upon Professor Silliman by those in whom he had a right to place confidence led to both extravagant expenditure and expectation along the whole line of development, so that the collapse of the vast organizations that during 1865-6 attempted to make real the prophecies that had been indulged respecting the possibilities of Ojai, Simi, etc., was more complete and disastrous than it ought to have been, and the reaction robbed the industry of the merit that justly was its due.

While in California in 1865-6 I became convinced that nearly all the wells that were located and drilled during that period were drilled in barren rock, hence their failure to produce oil was not surprising. The tunnels driven by Wheeler and Moss into the Sulphur Mountain and by others in the Newhall District, around the Pico Cañon, demonstrated the fact that petroleum as well as maltha existed in the mountains of this region; but the difficulties of drilling and the small returns realized in any instance, as compared with other wells, particularly in Pennsylvania, led to the most disastrous and complete discouragement for many years.

Added to this was another class of facts scarcely less discouraging. Repeated, and in many instances very costly, experiments fully established the fact that in California petroleum technologists had a new substance to deal with from which commercial articles identical with those obtained from Pennsylvania oils could not be made. The illuminating oils were small in quantity, but they were beautiful in appearance, and were only found to be different from Pennsylvania oils when they were burned; the differences having always from that time to this presented a difficulty in the way of commercial success that is fundamental. In the early days of refining, when it was taken for granted that petroleum was petroleum, wherever found, the petroleum obtained in Southern California, for the most part from tunnels, was attempted to be refined by simple distillation and treatment, as was at the time the custom in Pennsylvania. At this period (1865-6) the technology of Pennsylvania petroleum was extremely simple. Naphtha was a drug in the market and was forced into the burning oil or was burned under the stills, while, with stills being for the most part run to coke, the lubricating oils were dark in color, rank in odor and

generally in ill-repute. When the attempt was made to treat California oils in the same manner, it was found that there was but little naphtha, not much more burning oil, a large proportion of an oil that was neither burning oil nor lubricating oil, and a small amount of oil dense enough and with body enough for lubrication. Wheeler came back from San Francisco, where a trial run had been made, and, in language more graphic than polite, declared that the stuff was "all d—d middlings."

Soon after Professor Silliman took a barrel of Ojai tar (maltha) to Boston and treated it in the experimental still used at the Downer Kerosene Oil Company's works. He produced a certain percentage of illuminating oil. At about the same time I succeeded by distilling the petroleum from the Canada Laga and Pico springs and from the tunnels in Wheeler's Cañon and also a specimen of maltha from the same pool on the Ojai from which Professor Silliman's barrel came, in increasing the yield of illuminating oil to a very respectable percentage. But while the illuminating oil thus produced was colorless and brilliant, it was peculiar, and could never be sold, so far as I have been informed, on its own merits in competition with illuminating oils made from Atlantic coast petroleum.

In this condition the matter rested for many years. A few barrels of oil were produced each year. Some of it was treated, but most of it, so far as I can learn, was sold crude for fuel.

About 1880 a new era dawned. Several gentlemen who had had large experience as oil producers in Pennsylvania, after a thorough study of the stratigraphy of the Sulphur Mountain and the ranges bordering the Santa Clara Valley, located a number of wells on the Ojai ranche and in the Sespé and other cañons that greatly exceeded in productiveness any wells formerly drilled in this region. The location of these wells was made on an entirely different principle from that which determined the location of wells in 1865. With few exceptions the outcrops of bitumen throughout this region are on hillsides into which the strata dip at a high angle. At the foot of these hills the maltha and asphaltum have often accumulated in extensive beds that with the accompanying rubbish sometimes amount to even thousands of tons.

The figure illustrates the situation. A careful study of the section shows conclusively that the well of 1865 might be drilled to any depth without reaching oil, while the location of 1880 presents only mechanical obstacles to the ultimate penetration of the oil-bearing strata. The problems of well-boring in this region present many difficulties. The formation is in the middle tertiary. The rocks are soft and friable and are tilted at very high angles. The wells in western Pennsylvania, after the surface water is cased off at about 300-400 feet, may be drilled to great depths as dry holes. In Southern California, on the contrary, the well must be cased to the bottom, and drilled wet, as it is impossible to case off the water. The well is first started about 12 inches in diameter and the casing driven until it can be forced no further; a second size that will just run inside the first is then inserted and driven like the first until the pressure of the yielding mass of earth and rock holds it too firmly to admit of its being driven further; when a third size is inserted, and so on until a size too small to admit of further drilling is reached. I think few wells 2000 feet deep have been drilled by this method in this region. It is obvious that the difficulties of locating and drilling wells here are very great and that in many instances a well may fail of yielding oil within a few feet of a valuable deposit.

It is but just to myself to say that I advised the superintendent of the California Petroleum Company, operating upon the Ojai ranche in 1865-6, to locate wells at the east end of the ranche, in precisely the location since de-

terminated upon. The successful wells in the Torrey and Sespé cañons have since been located upon the same principle. See the figure.

It is also a fact worth noting that the tunnels driven into the Sulphur Mountain by Wheeler in 1865, the location of which I have elsewhere described, have yielded oil continuously from that time to this and are still yielding oil in moderate quantity.¹

The oil having been obtained, a refinery was constructed at Santa Paula and a pail of the product manufactured into various articles for which a market could be secured. Unlike the natural oils obtained from springs, the oils from wells contained a considerable proportion of naphtha, even light enough to be suitable for use as gasoline. No illuminating oils are produced. The heavier naphthas and oils of a density suitable for illuminating oil are separated and sold without treatment as gas oil. A considerable proportion is then run off as crude lubricating oil, and the

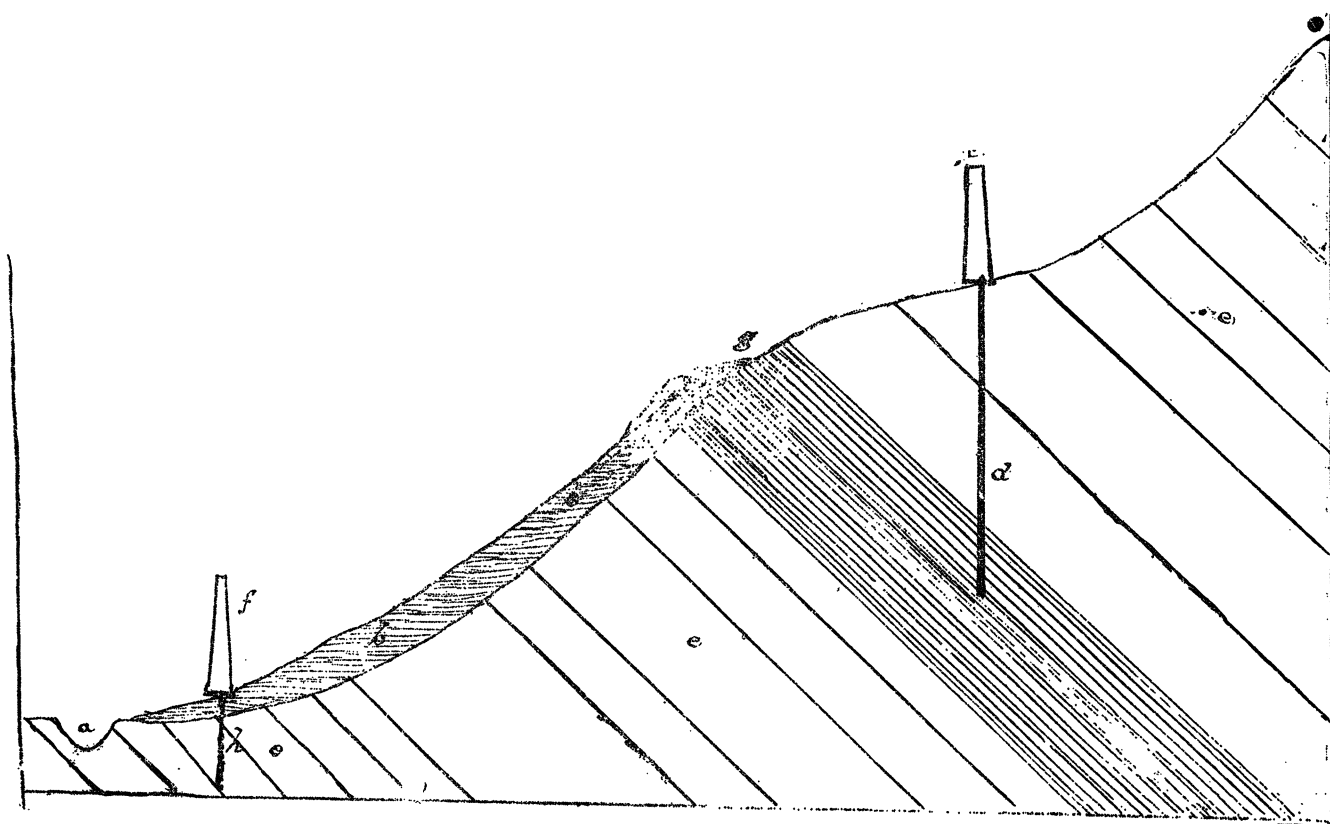
for structures, superior both in durability and appearance to any ordinary form of shingle.

This pure asphaltum is also used as a basis for paints and for coating paper, its purity as bitumen and its freedom from coke and other injurious substances rendering it greatly superior to coke, pitch and many cheaper and undesirable forms of natural bitumen.

Printer's ink of very superior quality is also made one of the products of this remarkable technology.

Besides the refinery at Santa Paula there is another establishment at Alameda Point, in San Francisco harbor, where oils from this region are given similar treatment.

This industry is in its infancy. The purposes to which these remarkable products can be applied are only partially known and very imperfectly appreciated. It is not only my intention to call attention to the fulfilment of predictions made in 1866, that the oil interests of Southern California would ultimately yield a profitable return upon



a, stream at foot of hill; *bb*, mass of maltha, asphaltum and rubbish; *c*, derrick of 1880; *d*, well of 1880; *eee*, barren sand stone strata; *f*, derrick of 1865; *g*, spring of water and maltha from oil-bearing strata pierced by well *d*, of 1880; *h*, well of 1865 in barren sand stone strata.

residue remaining in the still is run out and allowed to cool. This residue is a hard, brilliant, black solid. It is made for different purposes of different grades and degrees of hardness, the hardness depending upon the amount of the crude lubricating oil that is allowed to remain in the residuum. This material is a very pure (almost chemically pure) asphaltum and possesses some peculiar and very valuable properties. Straw board or wood pulp may be saturated with it and rendered nearly inert to acids and alkalis unless in concentrated solution. Straw board cut in suitable sizes may be saturated with it and made into a solid water-proof shingle that when painted forms an elegant and durable external covering

capital invested; but to also call attention to the great scientific interest attaching not only to the geology but technology of the unique and hitherto unfamiliar products of this remote region.

—It is understood that the "History of the United States Navy," upon which Mr. Edgar Stanton Maclay has been engaged for the last nine years, is now nearing completion. It is a curious fact that no complete history of the navy has been published since Fenimore Cooper's time, and Mr. Maclay's elaborate work will meet a demand which has grown stronger since the public became interested in the building up of our new navy. Mr. Maclay's history comes down in 1894. D. Appleton and Co. are the publishers.

¹ Reports of the Tenth Census of the United States, Vol. X., Petroleum, p. 68, plate XI.
Geological Survey of California, Geology, Vol. II., appendix p.

INTERPRETATION OF MAYA GLYPHS BY THEIR PHONETIC ELEMENTS.—PART II.

BY HILBORNE T. CRESSON, A.M., M.D.

PROCEEDING with the analyses begun in Part I of this article, there is on Plate II, fig. 14, a glyph which appears in the Codex Cortesianus, Plate 16, among a series of five glyphs just above an ideo-phonetic drawing of *Hun Kimil*. In fig. 171, Plate I (see *Science*, No. 567, vol. xxii.), attention has already been called to one of this series of glyphs and the suggestion made that the phonetic elements composing it recall the name of *Kukulkan*. It is but a variant of fig. 160, Plate I; see analysis of the glyph given in Part I of this article. The glyph to the left of this, the analysis of which is given on Plate II, figs. 226, 227, 228 to 234, reads *ah chun Kan*, and by reference to the Codex Cortesianus, Plate 16, it will be seen that there is still another which is a variant of it, repeating *ah-chun-can*. Next to it, reading from right to left, is the glyph referred to above, fig. 14, which we analyze on Plate II, figs. 15, 16, 17, 18, 19, 20, as *Xakan-ik*—"the revolving wind." Reference will be made to this presently. The last of the series (See Plate 16, Cortesianus) is the glyph Plate II, figs. 240 to 245; the elements of which, as in the glyphs shown at figs. 1 to 5, 6, 7, 8, 9 of the plate (see day signs of Landa; Troano 6), express "Hun-ki"; the *m* and *il* do not seem to be expressed in any of the glyphs of *Hun-Kimil*. Other examples of abbreviation are to be remarked, as in the day sign *Muluc*, generally expressed "u-uk," and in the day sign *Lamat*, generally expressed "Lamak," at times "am-ak" (see glyphs day sign *Lamak* in *Chilan Balam* of *Kaua*); at times "ach" or "ak" (see Troano 6, 11, 18, 30, 31, 32, 34). In looking over a series of analyses of the day signs, all of which interpreted by my list of phonetic elements have yielded the names suggested by Landa, the names of the day signs *Muluc* and *Lamat* are less clearly expressed by the elements composing them than those of the other day signs. The glyph fig. 10, Plate II, taken from the *Chilan Balam* of *Kaua*, gives a series of these elements which are similar to those we have derived from the codices; using the elements fig. 11 as *hun*, and fig. 12 as *un*, we obtain "hun" or "hu-un"=*hun*. The syllable *Ki* is derived from the value assigned this element on my phonetic list (see Part I of this article, *Science*, No. 567, page 326), Plate I, figs. 1 and 2=*ka v/s*; thus: *Ka*, *Ke*, *Ki*.

Vowel fluctuation, I repeat, must not be overlooked in this method of interpretation now described by me; in fact it is my opinion that the Maya glyphs can never be interpreted without considering it as an important factor in the work. The method of the Touaregs of the Sahara in deciphering their manuscripts affords a clue, for it is said that when the natives undertake this difficult task they begin by spelling the consonants aloud . . . applying to them in succession the various vowels until a word is found that makes sense. In fact, it is absolutely necessary to proceed in a like manner in the Maya script, only, instead of chanting, the combinations can be worked out with pencil and paper. In an endeavor to interpret a series of glyphs the amount of labor that this requires can be duly appreciated. The rest of this article will simply be devoted to an explanation of these fluctuations, adding, where necessary, a few remarks upon the interpretations made.

Fig. 21 is a well known compound glyph, variants of which frequently appear in the hieratic script and the codices, especially in the Peresianus (Plates 2 to 10). The phonetic elements of one of its components, Fig. 22, it will be seen by reference to figs. 23, 24, 25, Plate II=*bacab*. It is a variant of the day sign *Been* and was evidently used by the scribe to express *be*, derived from its phonetic value

of *ba v/s*. The next component is fig. 26, where we have the curved aspirate line, fig. 27=*xa v/s*, *cha v/s*, the serpent curve, fig. 28=*Kan*, *chan*, *Ka v/s*, and the parallel line=*ik*, derived from one of its values of *ka v/s*. We have here a repetition in a new combination of the word *xakau-ik* = "The Revolving Wind," which has already been suggested by the glyph fig. 14, Plate II. The element fig. 30 is in fact closely allied to the *x*, *ch*, and *sh* sounds, the curved element, fig. 28, supplying the monosyllable *Kan*; this associated with the curved aspirate line, fig. 127, gives *xan* or *xakan* or *shakan*. The rest of the phonetic elements composing this glyph, fig. 31, repeats *ik*, fig. 32=*cha*, fig. 33=*kan*, fig. 35=*ik*. The enclosing outline of this glyph is not unlike the single curved *Kan* line, fig. 34, and it seems like a variant of fig. 228, also a *Kan* element and a component of the compound glyph, fig. 226, with the element fig. 227 placed above, this element, fig. 227, also appearing in fig. 21, fig. 32, just above fig. 33. The enclosing outlines of certain glyphs have at times an ideographic significance which it would be well for Maya paleographers to bear in mind. In this case fig. 33 has for its principal phonetic element a motive obtained from the serpent line, fig. 192, Plate I, *Science* No. 567; see also fig. 122, Plate I. The outline enclosing it is adapted to the curve of this element and is evidently a determinative sign, being purely ideographic. The glyph fig. 27, therefore, repeats *Bacab xakan ik* = "Bacab of the revolving wind," or, still better, "Of the shifting or changing wind." The sense intended is evidently *Bacab* = "ruler," *xakan ik* = "changing wind," or "wind that blows from the cardinal points." As this glyph is intimately associated with the *bacab* and *chak* cult in the Peresianus, the interpretation, it cannot be denied, is a probable one. If space permitted much interesting material, the results of analyses of glyphs in other codices, could be brought to support the truth of the interpretation given.

Fig. 36 is a glyph which appears in the Codex Peresianus, Plate 17. Its phonetic elements and their values are given in figs. 37, 38, 39, 40=*xakan ik*, a third repetition of this sentence. The glyph fig. 36, Plate II, is attached to the support of a representation of a straw house (*xanil-na*); see Plate 17, Peresianus. Underneath the house is the representation of *Kukulkan* in the act of turning over or revolving, symbolizing the sentence *xakan-ik* (or it may be *chak*, *kan*, *ik* = *Chak*, or "God of Serpents and Wind"). There are some interesting facts in connection with this figure, which is ideo-phonetic. Its ideographic sense, the action of revolving, has just been suggested. The color of the garment covering the body of the *chak* is green=*xan*, on which are small squares of a darker green color arranged by twos (= *Ca*) and by fours (= *Kan*), suggesting *xakan*; the black squares attached to the roof arranged in pairs = *Ka v/s* (= 2) or *ik*, together with the red color back of the figure (= *chac*) and the yellow colors of the straw roof (*Kan*=yellow). All of these accessories are ikonomatic and recall *Chak-kan-ik* or *xakan-ik*, supporting the interpretation that we have made of the glyph fig. 36, Plate II, which is attached to the support of the roof of the straw house. I am loth to consider all of these facts the result of mere accident; there is too much method in their arrangement. The colors used are without doubt ikonomatic. On Plates 15, 16, 17, 18, *Peresianus*, there are many repetitions of the words, *chak-ikal* = "the hurricane" and "*xakan-ik*" = "the revolving" or "whirlwind." We find the sentences repeated in the Dresden Codex and in certain parts of the script of *Palenque*—notably on the bas-reliefs representing *Kukul-kan* as *Chak* of Water and Wind, that at one time stood at the right and left of the doorway of the temple of the Four Winds and *Chaks* at *Palenque* (so called Temple of the Cross); "the cross" being simply, as Brinton first suggested, a wind symbol.

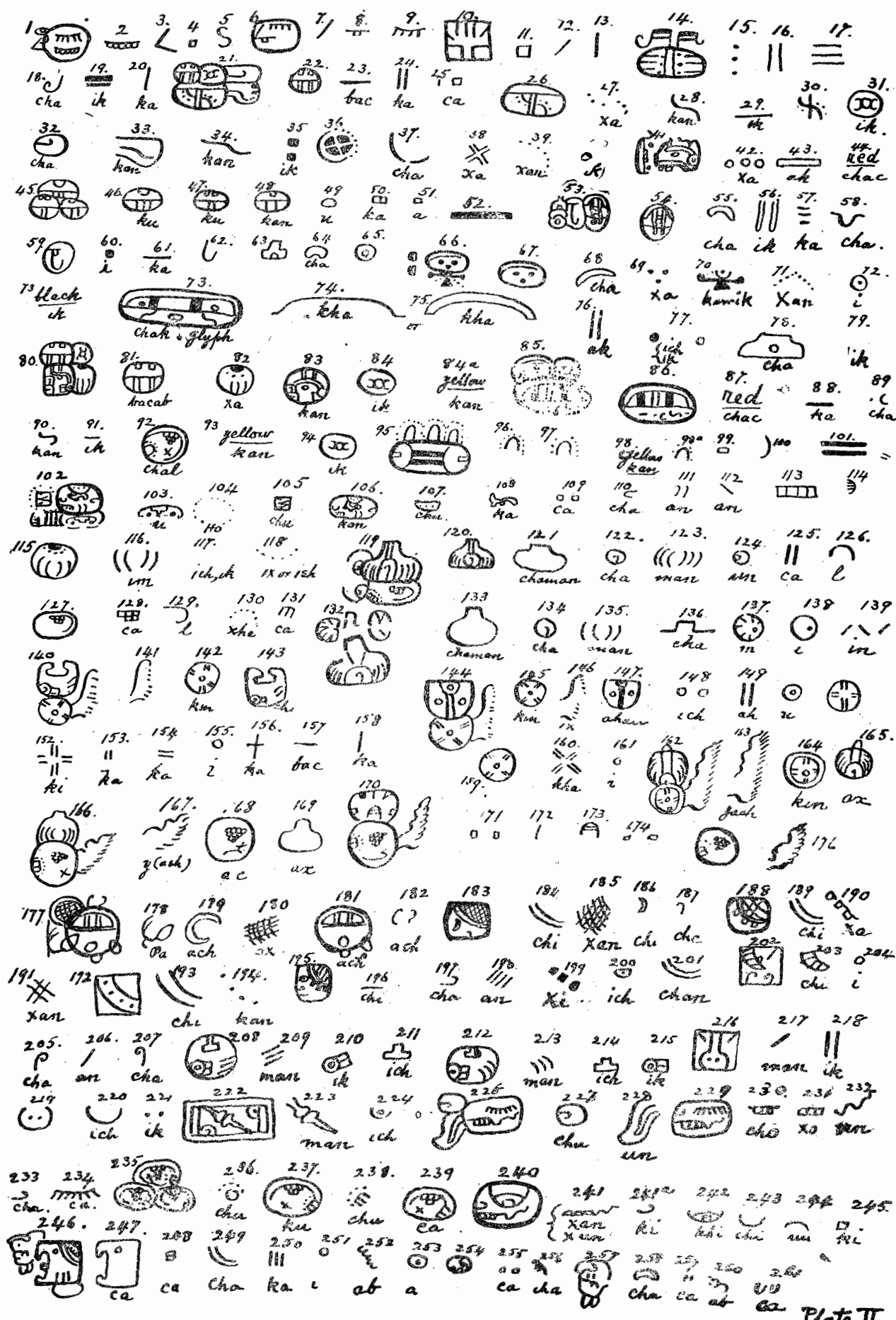


Plate II.

Before proceeding further it must be remarked that in fig. 40, Plate II, we have given the color black, which plays such a conspicuous part in the glyph, fig. 36, the phonetic value of *ek* or *ik*. It frequently appears with these phonetic values in Maya script, and it is my opinion that red may also have the phonetic value of *Chac*, *cha* v/s, yellow *Kan*, *ka* v/s, and green *xan*, *xa* v/s. It will be impossible to discuss the subject here; we leave the suggestion to time to decide, but attention is called to the fact that color seems to be ikonomatic in Maya script. Above the *ideo-phonetic* figure in Plate 17, Peresianus, (a compound of ideographic suggestion and phonetic elements), is a series of glyphs whose analyses are made on Plate II, figs. 41 to 73. It will be observed that many of the phonetic values assigned by me to certain phonetic elements are being repeated in new combinations with probable results. The interpretation given is *n-chak Kukulkan*, *chakikal*, *Chakanik*. There are two more glyphs in this series on Plate 17 (Peresianus), but as they are somewhat erased it would be necessary to compare them with others on Plates 15, 16, 18, (Peresianus), and other parts of this codex, which is here impossible. The series of glyphs on all of the plates referred to, viz.: 15, 16, 17, 18 (Peresianus), read from the lower right hand glyph toward the left, thus:

F. E
D. C
B A

and repeat name of *Kukulkan* with reference to his title of God of Wind and ruler of the cardinal points. The order of repetition of the words given by the glyphs varies in some of the plates. The series is in fact a repetition of the compound glyph of the Peresianus, as shown in my plate, fig. 21, with the addition of the title *Chakikal*, thus: *Bacab*, *xakan ik*, *Chakikal* = "Ruler of the Cardinal Points, God of Wind." (*Bacab* = ruler, *xakan-ik* = the "cardinal points" or the winds that revolve around it; *Chak* = "God," *ik* = "wind," or this latter may be read = "hurricane.")

Especial attention is called to the glyph fig. 45 in this series, where three *Kan* glyphs express the name *Kukulkan*, their different phonetic values being indicated by the small *phonetic additions* attached to the top of the glyphs inside of its enclosing circle, see figs. 45, 46, 47, 48, 49, 50, 51. The name of *Kukulkan* is also repeated on Plate 23, Peresianus; three *Cuuc* glyphs being used, their values being changed by the phonetic additions attached. See figs. 235, 236, 238, 239, Plate II.

Fig. 73 is a well-known glyph in the Peresianus. It has been designated by me the *Chak* glyph from the fact that the phonetic elements within it express that word and the figures attached to the glyphs in the Peresianus, there is good reason to think, are *chaks* or *bacabs*, supporting my analysis of its phonetic elements. The phonetic elements of which it is composed are frequently repeated in Maya script and are among the most primitive of those represented in Part I of this article, published in *Science*, No. 567.

A repetition of the title *Bacab-xakanik*, with the yellow color appearing with phonetic value, is given in the series, Plate II, figs. 80 to 84, taken from Plate 16, Peresianus. See also series figs. 85 to 101. The glyph fig. 102 my analysis indicates to be that of *u Hvoobnil-Kan*. The dotted aspirate circle, fig. 104, gives *Ho*, derived from the phonetic value of *cho* or *sho*, *xo* v/s. The square, fig. 105, encloses the same elements that are found in the day sign *Chuen*, and its phonetic value *cha* is indicated by the square in which it is enclosed—the square, generally, being associated with *á*, *Ku* v/s, sounds. If the same elements referred to were in a circle they would probably be *cho* or *chu*, as the circle is intimately associated with

i, *o*, *u*, *ch*, *ik* sounds. The square and circle are probably vowel elements; see Article I, Plate I, figs 27, 43.

NOTES ON THE GENUS STROMATOCERIUM.

BY HENRY M. SEELY, MIDDLEBURY, VERMONT.

ONE wishing to recall the typical form of the genus *Stromatocarium* turns to Hall's monumental work, "Palæontology of New York," and in Vol. I., p. 48, finds the description of this well-marked genus. The horizon of *Stromatocarium vagosum* is that of the rocks of the lowest member of the Trenton period, that is, the Black River. This fossil is accepted as a guide in determining the rocks of that epoch.

That this form should flit across one geological horizon, should come and go, having no ancestry and leaving no descendants, seems strange. But this sudden appearance and disappearance is more apparent than real. It may not be possible to trace exact lineage, but likenesses and relationships are quite evident. The related forms are *Cryptozoon* below and *Stromatopora* above. It is true these are somewhat widely separated, both by structure and by stratigraphical position. Yet in general structure they are so alike that one has often been mistaken for the other.

We may briefly consider the stratigraphical relation of the *Stromatocarium* to the *Cryptozoon* in the rocks lying below. Immediately beneath the Black River is the Chazy, the rocks of which at their best estate have a thickness of near 900 feet. Beneath the Chazy lies the Calciferous, with its distinct divisions of rocks, the formation having a thickness of near 2,000 feet.

The rocks of these two epochs bordering Lake Champlain and filling so great part of the valley between the Green Mountains and the lake have a recognized likeness. Had not the name, Champlain, been preoccupied, this term could have been applied with appropriateness to the time period which would be constituted of the two epochs, Coazy and Calciferous.

The Chazy rocks may be looked upon as a wedge separating the Calciferous from the Black River rocks. The edge of this wedge in some places thins down and disappears, so the Black River is let down in contact with the Calciferous. The stratigraphical separation between the *Cryptozoon* and the *Stromatocarium* thus becomes zero.

So far as horizon is concerned the *Cryptozoon* may have clambered up into the Black River rocks. But the piling up of a little less than a thousand feet of Chazy rock, mostly calcareous, indicates the passage of a long interval of time. The sponge-like forms of the Chazy are not *Cryptozoa*. The concentric structure has been retained by several, yet they are clearly distinguishable from that fossil. One of the most noticeable of these forms is a *Stromatocarium*.

The genus as characterized by Professor Hall may admit of considerable variation, yet these Chazy forms in all essentials correspond to the type. They differ, however, from *Stromatocarium vagosum*, and so widely do they diverge that the difference can hardly be less than specific. They have been studied with some care and specific names applied, but a general statement of position and character will be enough for the present.

The divisions of the Chazy rocks may be properly designated from below upward A, B, C. Distinct forms of *Stromatocarium* are found in each. That found in A, the lowest division, has a growth in shape and sometimes in size like the old-time straw bee hive. It appears in B but somewhat modified in form. The special form in B is peculiar in growth and massiveness. The fossil is made up of a series of corrugations, these being from a quarter of an inch to a half inch in height. Blocks three feet by

eight lifted from the quarry are sometimes made up mostly of this form. In division C are several forms; a noticeable one has its fresh surface covered with mastoidal eminences; these when cut down by weathering leave a series of beautiful rings or concentric circles. Examples of this species are not unlike an inverted saucer in shape.

The species found in A may be collected at Chazy, N. Y., and at many localities in Vermont; those in B and C at their appropriate horizons at Isle La Motte, Vt. The form in B is incidentally largely distributed through the country and will be found when looked for in the tiled floors of almost every public building where Isle La Motte marble has been used. In museums, too, it will be found under title of "Isle La Motte banded limestone." The place above all others for display of *S. vagosum* is a little island, at the entrance of Button Bay, three miles south of Fort Cassin, Vt., where a layer 20 to 30 inches thick is exclusively of this form and *Columnaria alveolata*, H.

The following facts are evident: (1) the genus *Stromatocentrum* does not make its first appearance in the Black River; it is there rather in its decadence; (2) it appears in the lower Chazy, following close upon the *Cryptozoon*, and persists through the different divisions; (3) it cannot of itself be trusted as a safe indication of the Black River.

However, it should be noticed that *Stromatocentrum vagosum* is most frequently paired with *Columnaria alveolata*, and the presence of the two forms establishes beyond question the presence of the Black River.

DR. CALLAWAY AND THE PRODUCTION OF CRYSTALLINE SCHISTS BY DYNAMO- METAMORPHISM.

BY J. W. REDWAY, F.R.G.S., MT. VERNON, N.Y.

ABOUT fifteen years ago, while setting a piece of heavy mining machinery that revolved on a vertical shaft, work was brought to a stand by the discovery that the journal, intended as a chair and box for the cone-shaped bearing, was considerably too small. A speculative workman thought it might wear down to shape, however, and started the machinery. The experiment, though of doubtful success from a mechanical standpoint, was brilliantly successful in another light. The bearing and journal, both of drop-forged steel, were welded to each other and broke into a dozen pieces. The interesting point, however, was the fact that two forgings of laminated steel under the agency of heat were converted to a metamorphic form. At the surface of welding the laminated steel became crystalline, and even the parts at some distance became semi-crystalline. It was a fair illustration of what is now called dynamo-metamorphism.

In a very remarkable paper presented to the *Quarterly Journal* of the Geological Society of England, Mr. Charles Callaway, D. Sc., F.G.S., has published the result of his researches on the origin and formation of certain crystalline schists found in the Malvern Hills, in the west of England. A close study of these schists during a period of five years has brought Dr. Callaway to the conclusion that they were produced by a dynamo-metamorphosis not different in essential principles from the illustration described in the preceding paragraph. Ordinarily, metamorphism in rocks may be briefly described as the change that a sedimentary rock undergoes when subjected to intense pressure in the presence of heat and moisture. The rock becomes more or less crystalline, and there is a tendency from homogeneity to heterogeneity in mineral structure. The production of metamorphism by the

shearing of rock and the gradual sliding or movement of the one mass upon the surface of the other is called dynamo-metamorphism. Neither the name nor the idea originated with Dr. Callaway, but the thorough exposition the subject has received at his hands entitles him to a foremost place among the pioneers in this field of research, and the results he has obtained are an important step in advance in the field of dynamic geology.

The Malvern Hills are mainly composed of masses of igneous rock, granitic in character, the constituents chiefly considered being binary granite and two kinds of diorite. In certain localities there are exposed bands of crystalline schist, apparently as seams of subsequent intercalation but really cataclastic in origin. These seams are the shear-zones within which the schist-making process occurred. Aside from the normal metamorphism which took place, the chief factor seemed to be a distinct shearing movement that resulted in a fusion sufficiently complete to produce plasticity.

Among the mechanical changes was the transformation of diorite into mica-gneiss. In the process of transformation the pulverized mineral not infrequently passed through an intermediate stage of laminated grit that simulated a sediment. A still more interesting change was the injection of potash and potassium feldspar into diorite, and a similar transference of the corresponding sodium salts into granite. In still other cases, diorite and granite were mutually interlaced. Chlorite and ferric oxide produced by the decomposition of diorite were injected or infiltrated into the cracks, cleavage and shear-planes of crushed granite and often migrated to a considerable distance, giving rise to an interfoliation of chlorite and biotite with the quartz, feldspar, and muscovite of the resulting gneiss.

The mineral changes may be classified as (a) decomposition, (b) transition, and (c) reconstruction. The massive rocks pass into schists through a process of decomposition, followed and partly accompanied by a process of reconstruction, in which the newly-formed quartz and feldspar crystallize, after the secondary consolidation. The chief mineral changes of the schist-making process are (a) the replacement of orthoclase by quartz and muscovite; (b) of plagioclase by the quartz and muscovite; (c) of chlorite by biotite and white mica; (d) and of biotite by white mica. The liberation of potassium from the granite is sometimes accompanied by silicification of the veins and the production of garnets. The reconstruction of feldspar is also a prominent feature in the metamorphism.

Among the chemical changes the following are noteworthy: (a) the mutual transference of sodium and potassium compounds between diorite and granite, also previously noted among physical changes; (b) the removal of sodium, potassium, magnesium, calcium, aluminium and iron compounds when diorite is converted to gneissoid quartzite; (c) the retention of aluminium and the elimination of alkaline compounds when diorite is metamorphosed to muscovite.

Dr. Callaway's researches involved the preparation of about 500 thin sections of rock for study with the microscope, and a large number of chemical analyses. His hypotheses are bold and ingenious, involving metasomatism on a large scale. Subsequent investigations, however, have not disproved them; on the contrary they have been strongly confirmed. It is interesting, moreover, to compare the work of Dr. Callaway with that of Mr. Van Hise on the schists of the Penokee iron-bearing series (U. S. Geol. Survey, Rep. 1888 and 1889, pp. 429 et seq.). The ideas shadowed in Mr. Van Hise's report could not have been more fully confirmed than they have been by Dr. Callaway, working independently at the same time on rocks several thousand miles away.

MEMORABILIA BOTANICA, I.

(Edited by Erwin F. Smith, B.S., D.S., Washington, D.C.)

CABINET WOODS AT THE FAIR.

ONE of the most interesting forestry exhibits at the Columbian Exposition was from New South Wales. The variety of their hard woods and the polish many of them take was a surprise to Americans. The only exhibit approaching it in beauty was that from Michigan. The woods of New South Wales must certainly come into extensive use at no very distant day. For novelties in cabinet ware nothing could be more attractive, and it would seem that such treasures need only to be exploited to find their way everywhere among lovers of the beautiful. In looking over this collection from the antipodes one could not repress a burst of thankfulness at finding it properly labeled. The exhibits from a number of countries, Spanish ones in particular, were robbed of much of their interest by indifferent labeling. To look over a large number of woods, all polished at great expense and some of them exceedingly beautiful, only to find Spanish or Indian names, was, from a scientific standpoint, rather discouraging, to say the least. In many cases one could not learn even the natural family, much less the genus and species. The matter is the more to be regretted since such opportunities for study come but rarely.

THE UNCERTAINTIES OF COMMON NAMES.

THE necessity for the more general use of scientific names in books of travel, economic works and various writings of a semi-scientific character, could not be impressed more forcibly than by this same forestry exhibit of New South Wales. For an American, especially if he desires to reach the common people, it is the most natural thing in the world to think everybody will know what he means by such names as white pine or red cedar. These names are not likely to be misunderstood in the United States, but if an author's writings are to be permanently useful to science the whole world over, then he must use the common language of science. To illustrate, New South Wales has an exceedingly varied flora, but not many of its genera, and very few, indeed, of its species, grow in the United States, and yet many of their common names are identical with our own. Plants of the United States and New South Wales, of very diverse genera, bear the same common name, e.g., according as one is American or Australian, elm means *Ulmus* or *Aphanathe*; tulip tree, *Liriodendron* or *Anopterus*; apple tree, *Pyrus malus* or *Angophora intermedia*; honeysuckle, *Lonicera* or *Banksia*; sycamore, *Platanus occidentalis* or *Cryptocarya obovata*; hazle, *Corylus* or *Pomaderris*; dogwood, *Cornus* or *Myoporum*; ironwood, *Ostrya* or *Tarrietia*; white cedar, *Cupressus* or *Melia*; mountain ash, *Pyrus americana* or *Eucalyptus virgata*; white pine, *Pinus strobus* or *Frenela robusta*; sassafras, *Sassafras* or *Doryphora*; red cedar, *Juniperus virginiana* or *Cedrela australis*; beech, *Fagus* or *Gemelina*; hickory, *Carya* or *Acacia*; swamp oak, *Quercus* or *Casurina*; box, *Buxus* or *Eucalyptus*; black oak, *Quercus* or *Casurina*; red ash, *Fraxinus pubescens* or *Alphitonia excelsa*; black ash, *F. sambucifolia* or *Cupania semiglauc*. Now suppose an economic writer of New South Wales to deal only in common names, and then imagine the confusion of an American reader, or reverse the case and imagine the perplexity of the Australian, if the diverse usage of the two countries were not known. The absurdity is apparent, and also the need of greater exactness in specifying what is meant by a common name. When the common name is in a foreign language the difficulty of arriving at the author's meaning is still greater, as everybody knows who has been compelled to depend on the imperfect and not seldom contradictory statements of lexicographers.

THE COFFEE DISEASE OF CEYLON.

PERSONS interested in coffee may have noticed in the Ceylon building at the Fair a big chart showing an astonishing decrease in the coffee product of that island during recent years. Formerly Ceylon was one of the great coffee producing regions of the globe, but within a decade the exports have fallen off so much that now the island scarcely cuts any figure in the total product of the world. Probably very few readers of *Science* know the cause of this. It has not been due to adverse legislation or to over-production in other localities, but almost solely to the ravages of a rust fungus, *Hemileia vastatrix*, which has destroyed the foliage on the coffee plantations in whole districts year after year. The losses have been so sweeping and disastrous as to bankrupt individuals, discourage planting and practically ruin a great industry. Dr. Haberlandt states that many of the large and beautiful coffee plantations can be bought to-day for one-tenth of their former value, the decrease of property values on account of this disease being estimated at about 10,000,000 pounds sterling. Recently it has been reported that the disease can be prevented by the use of copper fungicides. Owing, however, to the close planting of the groves, young trees under old and all interlacing, it is said to be impossible to spray with machinery and that the use of knapsack sprayers is too slow and expensive to be practical. The disease also occurs in Java, but lovers of the berry will be glad to know that it has not been reported from Mexico or Brazil.

BOTANY IN SECONDARY SCHOOLS.

FOR a long time the botanists of the country have recognized the sad state of botanical teaching in most of our high schools and smaller colleges. Chemistry and physics are taught experimentally, i.e., by laboratory methods, in all except a few hopelessly antiquated and fossilized schools, but botany is still taught quite generally by the old text-book-parrot method. Teachers do not seem to know that there is any better way, or that reciting lessons from a book is one thing, and the study of nature quite another. Indeed, the public mind itself, quite generally, needs to be disabused of the idea that science can be learned out of books. Books, when well written, are useful stimuli and valuable repositories of facts, but a man may study the printed page until he is gray without getting in touch with nature or acquiring the scientific spirit. Living, fruitful knowledge can come only from grappling directly with the phenomena of nature. This is why it is possible for students to take a three months' or six months' course in botany, so-called, and still have no interest in plant life, bringing away from their study nothing better than a meagre portfolio of incorrectly determined snips (there were some of these on exhibition at the Fair), a hopeless muddle of technical terms, and the lifelong feeling that botany is a very dry and uninteresting subject. On the whole, no instruction at all is preferable to such teaching. Those who have realized the badness of this sort of teaching have done what they could individually to improve it, but without any great measure of success. Now it is proposed to see if an organized effort will not be more fruitful. The subject came up for discussion in Section G (Botany) at the Madison meeting of the American Association for the Advancement of Science, and a committee was appointed to devise ways of improving botanical teaching in secondary schools. This committee will report to the Section next year, and if their report is approved it is hoped that it can go before the country with the endorsement and influence of the whole Association. Teachers who are groping about for

better methods, those who have already found good ways, and all who are interested in botanical progress in the United States will do well to correspond with the members of this committee,—Douglass H. Campbell, Palo Alto, California; N. L. Britton, New York, and Jno. M. Coulter, Lake Forest, Ill.

EMBRYOPHYTA ZOIDIOGAMA.

A RECENT double number of *Die Natürlichen Pflanzenfamilien* begins consideration of the higher cryptogams, the Embryophyta zoidiogama or Archegoniatae. This grand division of the vegetable kingdom is defined as follows:

"Plants seldom thalloidal, mostly differentiated into stem and leaves (cormophytic), and having two distinct generations. The proembryonal or sexual generation bearing antheridia in which spermatozoa are developed and Archegonia enclosing the egg cell, which is to be fecundated, and the canal cells, which change into slime prior to the act of fecundation. After fecundation the non-sexual embryonal generation or embryo arises by division of the egg cell and further growth, remaining a long time in connection with the proembryonal generation and being nourished by it."

The following subordinate groups are recognized, and the progress of systematic botany during the last forty years cannot be better understood at a glance than by comparing this system of classification with that given in Lindley's "Vegetable Kingdom."

(1) SUBDIVISION. BRYOPHYTA (MUSCINEI).

1. Class Hepaticae (Liver mosses).
 1. Sub Class Marchantiales.
 2. Sub Class Jungermaniales.
2. Class Musci (Musci frondosa, or Leafy mosses).
 1. Sub Class Sphagnales.
 2. Sub Class Andreaeales.
 3. Sub Class Archidiales.
 4. Sub Class Bryales.

(2) SUBDIVISION PTERIDOPHYTA.

1. Class Filicales.
 1. Sub Class Filices. Genuine ferns (Isosporae).
 2. Sub Class Hydropterides (Two sorts of spores).
2. Class Equisetales.
 1. Sub Class Isosporaeae.
 2. Sub Class Heterosporaeae.
3. Class Sphenophyllales.
4. Class Lycopodiales.
 1. Sub Class Isosporaeae.
 2. Sub Class Heterosporaeae.

This double number (91 and 92) brings Division 3 of Part I down to page 93, and deals with the following groups of liverworts: *Ricciaceae*, *Marchantiaceae*, *Jungermaniaceae anakrogynae*, and *J. akrogynae*. All by v. Schiffner, with many illustrations.

SOUTH KENSINGTON.

THE Kew Gardens are well known in the United States as the centre of an enormous amount of a conservative kind of botanical energy, mostly floristic, but it is not so generally known that Kew has a formidable rival at South Kensington. Indeed, in many ways, according to all accounts, and notably in the facilities offered to visiting botanists, and in the extent of its library, it is far ahead of Kew. The botanical library at South Kensington is now one of the best in the world, nearly \$100,000 having been spent on it within the last decade, and the collections are also valuable. The director, Mr. Carruthers, wishes it understood that South Kensington is in full sympathy with the new botany and that specialists from every quarter of the globe are welcome and will be given every possible facility, in the way of books and collections, for the pursuit of original investigation, whether of phænogams or cryptogams.

CURRENT NOTES ON ANTHROPOLOGY.—

NO. XXXIX.

(Edited by D. G. Brinton, M. D., LL. D., D. Sc.)

INSCRIPTIONS ON FRENCH MEGALITHIC MONUMENTS.

THE megalithic monuments of France are divided into great upright stones, *menhir*, groups of these, *gromlech*, and large flat stones superposed on others which are upright, *dolmen*. There are about thirty-five hundred of the latter in France, and still more of the former varieties. They used to be attributed to the Celtic Druids, but later writers hesitate to accept this identification. Some of them have figures inscribed upon them, not generally of men or animals, but apparently of a symbolic or even alphabetic character.

During the year 1893 two suggestive articles on these "alphabetiform" and other inscriptions appeared in the *Bulletins de la Société d'Anthropologie* of Paris, the first by Ch. Letourneau, the other by A. de Mortillet. In comparing the characters on the dolmen "des Marchands," in Brittany, with similar remains elsewhere, M. Letourneau made the interesting discovery that many of them were identical or very similar to those found in what are called the "rupestrian inscriptions" of Tunisia and southern Algeria. These are of Libyan origin, and by most recent scholars are held to preserve a form of writing older than the Punic alphabet, and akin to that which is seen on ancient Numidian mortuary tablets. This discovery is the more important, because the megalithic monuments can be traced from Brittany into northern Africa in an almost continuous line, indicating that those who constructed them followed this path, either in one direction or the other.

The figures reported upon by M. de Mortillet are from a series of these monuments in the vicinity of Paris. They do not present the "alphabetiform" appearance, but are crude representations of human beings, "in which the principal aim of the artist was to indicate the sex."

RELATION OF THE GLACIAL AGE TO MAN.

THE great event of the glacial period, or Ice Age, bears an important relation to the calculations of the appearance of man on earth. The most recent studies in post-pliocene geology are, however, far from unanimous on glacial questions, and this has reacted forcibly on writers about the origin of man. One who is generally very careful, the Marquis de Nadaillac, has actually been led in a recent article, of great merit, entitled "Les Dates Préhistoriques," to the extreme conclusion that "the remotest epoch to which we can assign the appearance of humanity on the globe can scarcely exceed 10,000 years."

He bases this conclusion largely on the writings of American geologists, as Warren Upham, Gilbert and Winchell, who from their observations of the gorge of Niagara, and other so-called "geologic chronometers," have reduced the period since the final departure of the great ice mass to six or seven thousand years.

Both these conclusions have very much the air of a *reductio ad absurdum*. They are in conflict with so many known facts and high probabilities in other directions that they disprove themselves, and indicate some radical error of theory. A much more plausible theory, which accounts for the "chronometers," and does not violate probability, is that which is advanced by Mr. F. B. Taylor, of a prolonged subsidence posterior to the ice age, the proof of which is in a continuous coast line from the Atlantic to Duluth. He is preparing to present the full evidence for this.

THE ANCIENT INHABITANTS OF SALT RIVER VALLEY,
ARIZONA.

A PUBLICATION highly interesting to the ethnic anatomist is a memoir recently published in Washington, entitled, "Human Bones of the Hemenway Collection in the United States Army Medical Museum," by Dr. Washington Matthews and Dr. J. L. Worman.

The valley of the Rio Salado, or Salt River, was explored by this expedition under the direction of Mr. Frank H. Cushing. It proved to be the seat of a pre-Columbian civilization of rather high type, which, according to the opinions of most, must have disappeared at least a thousand years ago. The human bones obtained from the old graves present a curious series of aberrations. Considered as a single series, they are far from presenting a uniform type. If that fact goes for anything, they must have been a tribe of very mixed blood. Generally they were brachycephalic (probably from cradling), and not tall. Their teeth decayed early in life, and were often misplaced and irregular. The Inca and Worman bones were abundant, almost beyond example. As for flattened tibias and perforated olecranons, they break the record for frequency. No other series yet measured equals them in these defects. The hyoid bones offer singular deficiencies in ossification. The cubical capacity of the skull is very low, about 1313.

The impression the anatomist receives from reading the memoir is, that he sees presented a people in a low and sinking stage of physical vigor, drifting toward rapid decadence and extinction. Just such a condition prevailed in Peru at the period of the conquest of Pizarro; and from this analogy in condition, social and physical, not from geographic or ethnic relations, should be explained, I think, the various resemblances in structure and social development which the authors of this memoir note and dwell upon (rather too forcibly) between these widely-sundered nations.

THE VEDDAS OF CEYLON.

The Veddas are a strange and ancient people, who live in the hottest and most pestilential swamps and forests of Ceylon, leading a thoroughly savage life, nearly naked, in temporary shelters, cultivating nothing, and avoiding as much as they can any intercourse with the other natives of the territory. Out of a total population on the island of two and three-quarters millions, they number only about 2500; but in ethnic interest they are the most noteworthy of all; for in them, it is believed, we have preserved the sole representatives of the original inhabitants of the island.

Excellent studies of them have been recently published by Drs. P. and F. Sarasin, in their large volume on the scientific exploration of Ceylon, and by Dr. Emil Schmidt, in the first number of *Globus*, for the present year. From these sources we learn that the Vedda belongs to the smaller races, the average height being about 1.45 meters; his color is medium brown, his hair slightly curly, his eyes black, his head narrow and small, with an average capacity of about 1200 c. c. His face is not prognathic, and, from the photogravures of Schmidt, he often has pleasing features and an agreeable expression. Except on the head, the hair is scanty, and in the details of his anatomy he betrays a general lack of development, which by some anatomists would be called a "pithecoïd" or ape-like tendency.

The Veddas have few institutions and faint religious observances; but the latter are not absent, as Herbert Spencer has asserted. The language is Singhalese, at least in great part; but it is probable that a certain stratum of it is connected with some of the Dravidian dialects of Southern India. The Veddas, indeed, apparently should be classed with that primitive stock which at some remote time divided into the various members of the Australo-Dravidian family.

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On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

Cats Hunting Snakes.

It was a novel idea to the writer, that of our domestic cat appearing in the capacity of a serpent-killer; but as two independent accounts have recently come to his knowledge, from competent observers, this note is sent to *Science*, partly for its interest and partly in the hope of eliciting further evidence.

A family living in southern New Jersey have a cat, not large or powerful, but very lithe and active, that has been in the habit of going off to the woods and returning with dead snakes of different species, up to three or four feet in length. After dragging it home, she would proceed to eat the snake and was often interrupted and the prey taken from her by members of the family, who were horrified at the proceeding. On one occasion, a violent flurry among the hens was noticed, and it was found to be due to the approach of a black snake, fully a yard long. The cat had reached the spot, however, before the family, and her *modus operandi* was witnessed. She attacked the snake by repeatedly springing upon it, and endeavoring to seize it with his teeth, immediately behind the head. After a few such assaults, the cat killed it, and in due time proceeded to eat it, as usual, although it was then removed.

On relating this incident in a company of scientific friends it was generally regarded as novel; but one gentleman described a precisely similar action witnessed by him in Harlem, N.Y. A disturbance was observed in the rear garden, and the large family cat was found making just

such attacks upon a garter-snake between two and three feet long. The snake was partly protected under a dense clump of rose bushes, and the cat had difficulty in seizing it, but kept springing at the neck, as in the other case. The gentleman at once interfered, and dispatched the reptile with a stick. But it would seem from these instances that snake hunting is a habit with some cats. Is it so with many? Perhaps some readers of *Science* can help us to judge how far it is familiar.

D. S. MARTIN.

The American Box Tortoise.

PERMIT me to call the attention of those interested in zoölogy to the North American box tortoise or *Terrapene (Cistudo)*. In working over the material so far collected we notice no mention of material from Georgia, Tennessee, Alabama, Kentucky, the Dakotas, New Mexico or western Texas. Neither are specimens reported from Mexico excepting Mexico City. Specimens are vaguely reported to have been found in Canada, but no specimens seem to be preserved and no authentic records are known. It is commonly supposed that the *Terrapene (Cistudo)* does not exist west of the Rockies. If any person has evidence to the contrary we would like to know it. We would request all who can give us aid on any of these points to write us. If possible we would like to receive specimens from any locality whatever. The comparatively fixed habitation of this genus renders a large collection including many localities highly desirable. Persons who may have any of these specimens on hand, but do not care to part with them, would confer a great favor by lending them. Favors rendered in this way would be fully appreciated and remembered. All packages or communications should be addressed to undersigned, Walker Museum, University of Chicago, Chicago, Ill.

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Why Have the Old Rods Failed?

When lightning-rods were first proposed, the science of energetics was entirely undeveloped; that is to say, in the middle of the last century scientific men had not come to recognize the fact that the different forms of energy—heat, electricity, mechanical power, etc.—were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known in regard to electricity a hundred and forty years ago; and among these were the attraction of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to dissipation of the energy involved was entirely ignored, naturally; and from that time to this has been the best endeavor of the interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that the electrical energy existing in the atmosphere before the discharge, or, more exactly, in the column of electric fluid from the cloud to the earth, above referred to, reaches its maximum value on the surface of the conductors that chance to be within the column of electric fluid; so that the greatest display of energy will be on the surface of the very lightning-rods that were meant to protect, and damage results, as so often proves to be the case.

It will be understood, of course, that this display of energy on the surface of the old lightning-rods is aided by their being more or less insulated from the earth. But in any event the very existence of such a mass of metal as an old lightning-rod can only tend to produce a disastrous dissipation of electrical energy upon its surface,—to "draw the lightning," as it is so commonly put.

Is there a Better Means of Protection?

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, the question arises, "Can an improved form be given to the rod so that it shall do this dissipation?"

As the electrical energy involved manifests itself on the surface of conductors, the improved rod should be metallic; but, instead of making a large rod, suppose that we make it comparatively small in size, so that the total amount of metal running from the top of the house to some point a little below the foundations shall not exceed one pound. Suppose, again, that we introduce numerous insulating joints in this rod. We shall then have a rod that experience shows will be readily destroyed—will be readily dissipated—when a discharge takes place; and it will be evident, that, so far as the electrical energy is consumed in doing this, there will be the less to do other damage.

The only point that remains to be proved as to the utility of such a rod is to show that the dissipation of such a conductor does not tend to injure other bodies in its immediate vicinity. On this point I can only say that I have found no case where such a conductor (for instance, a bell wire) has been dissipated, even if resting against a plastered wall, where there has been any material damage done to surrounding objects.

Of course, it is readily understood that such an explosion cannot take place in a confined space without the rupture of the walls (the wire cannot be boarded over); but in every case that I have found recorded this dissipation takes place just as gunpowder burns when spread on a board. The objects against which the conductor rests may be stained, but they are not shattered.

I would therefore make clear this distinction between the action of electrical energy when dissipated on the surface of a large conductor and when dissipated on the surface of a comparatively small or easily dissipated conductor. When dissipated on the surface of a large conductor,—a conductor so strong as to resist the explosive effect,—damage results to objects around. When dissipated on the surface of a small conductor, the conductor goes, but the other objects around are saved.

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Franklin, in a letter to Collinson read before the London Royal Society, Dec. 18, 1755, describing the partial destruction by lightning of a church-tower at Newbury, Mass., wrote, "Near the bell was fixed an iron hammer to strike the hours; and from the tail of the hammer a wire went down through a small gimlet-hole in the floor that the bell stood upon, and through a second floor in like manner; then horizontally under and near the plastered ceiling of that second floor, till it came near a plastered wall; then down by the side of that wall to a clock, which stood about twenty feet below the bell. The wire was not bigger than a common knitting needle. The spire was split all to pieces by the lightning, and the parts flung in all directions over the square in which the church stood, so that nothing remained above the bell. The lightning passed between the hammer and the clock in the above-mentioned wire without hurting either of the floors, or having any effect upon them (except making the gimlet-holes, through which the wire passed, a little bigger), and without hurting the plastered wall, or any part of the building, so far as the above-said wire and the pendulum-wire of the clock extended; which latter wire was about the thickness of a goose-quill. From the end of the pendulum, down quite to the point, the hammer was exceedingly rent and damaged. . . . No part of the hammer or of the wire, between the clock and the hammer, could be found, except about two inches that hung to the tail of the hammer, and about as much that was fastened to the clock; the rest being exploded, and its particles dissipated in smoke and air, as gunpowder is by common fire, and had only left a black smoky track on the plastering, three or four inches broad, darkest in the middle, and fainter towards the edges, all along the ceiling, under which it passed, and down the wall."

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